Appendix D: Supporting Documentation for Watershed Characterization, Part II

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Using Appendix D

The purpose of this appendix is to provide the detailed methods, results, and supporting documentation that are the underpinnings of the main body of the report but to detailed or extensive to report there. This appendix follows the order in which the individual steps are presented in our methods document (Gersib et al. 2004). Individual steps were included in this appendix only if methods were changed or where detailed results needed to be documented.

Introduction

Natural Resource Inventory and Assessment

Natural resource inventory and assessment are essential to quantifying the magnitude of potential project impacts to aquatic and terrestrial resources. We use this information to identify key natural resources within the project limits of construction that warrant priority consideration for avoidance and minimization, while gaining understanding of the type, magnitude, and functions of natural resource impacts that may require mitigation.

Project limits of construction are confined to narrow strips on each side of I-405 and SR-520. An accurate estimate of direct impacts to regulated resources is not possible because project alignment has not been finalized. For planning purposes, we assume that all natural resources within the project area will have potential be directly impacted by the project. While we know that actual project impacts will be substantially lower than the worst-case scenario, we use these potential resource impacts to ensure that all potential types of natural resources at risk are identified, the extent of potential impacts quantified, and functions assessed that may require mitigation.

I-405 / SR-520 Project Setting

This project comprises two major freeways, I-405 and SR-520 within King and Snohomish Counties in Washington State. Located east of Lake Washington and running from Bellevue through Bothell, Washington, both freeways run through highly urbanized and urbanizing areas.

The “I-405 Congestion Relief and Bus Rapid Transit Projects Corridor Final Environmental Impact Statement” (Washington State Department of Transportation 2002) contains the overall preferred alternative for I-405. WSDOT based the preferred alternative on Alternative 3 from the draft Environmental Impact Statement, with minor changes. Proposed improvements to I-405 corridor and SR-520 are a part of the preferred alternative. Under the preferred alternative, WSDOT proposes to substantially improve mobility for rapid transit, high occupancy vehicles, and for general-purpose traffic. Improvements include arterial high occupancy vehicle priority for transit, additional park-and-ride capacity, more bus stations, transit center improvements, freeway high occupancy vehicle direct access, two new lanes in each direction on I-405, and improvements to major interchanges.

The I-405 project extends from a quarter mile south of the SR-524 interchange to the I-90 interchange (Figure 23 in the main document, Study Area Base Map). The northern boundary represents the topographic divide between North Creek and Swamp Creek drainages in Snohomish County. The southern boundary is situated in Bellevue near Newport in King County. Parts of a number of cities, including Newcastle, Bellevue, Redmond, Kirkland, Woodinville and Bothell lie within the I-405 corridor, as do adjacent unincorporated areas of King and Snohomish Counties. The freeway is the region’s main north-south travel corridor east of I-5. Land use in the I-405 corridor includes primarily commercial and residential areas. The freeway crosses many streams that drain into Lake Washington, including North Creek, the Sammamish River, Juanita Creek, Forbes Creek, Yarrow Creek, Sturtevant Creek, Kelsey Creek, and the Mercer Slough, as well as several unnamed streams.

The SR-520 project stretches from west to east, beginning at the Evergreen Point floating bridge in Bellevue and ending at the freeway's terminus with SR-202 in Redmond. State Route 520 provides access from the Eastside across Lake Washington into Seattle. The freeway crosses the cities of Medina, Hunts Point, Clyde Hill, Yarrow Point, Bellevue, and Redmond. Residential areas, including high value waterfront homes, and commercial areas are the primary land use. SR-520 traverses Yarrow Creek, Kelsey Creek, Bear Creek and the Sammamish River.

Major streams and tributaries within the study area support wetland and riparian resources that provide habitat for salmon and other fish and wildlife resources.

Project Area

Limited data exists on current and future highway project area boundaries. In lieu of actual right-of-way data, a shape file named "Estimated Existing Right-of-Way" was created for the purpose of analyzing potential project impacts for our watershed characterization work. In ArcMap, polygons were created for the existing I-405 and SR-520 highway project area using the 1998 orthophotos as a background, with the watershed study area as the boundary. These polygons were then merged into a final shapefile to create the estimated transportation corridor highway project area, that we use to define our project area. The fence line and all boundaries of this shapefile are visual estimates of the project area, and do not depict legal property boundaries. The estimated highway project area boundaries are not intended for use at a design level of analysis.

Identify Project Impacts to Aquatic and Terrestrial Resources

Regulated resources within a highway project area can include wetland, floodplain, and riparian/stream habitat impacts. In this section, we characterize the type, magnitude, and condition of these resources within the project area and gain understanding into the types of functions they are providing.

While the identification of natural resources within a project area is possible, quantifying the direct impacts of fill to these resources is not possible at this early stage of project planning.

Wetland Inventory

Methods

WSDOT wetland scientist Joanne Neugebauer-Rex conducted a wetland inventory within the I-405 SR-520 project area and private lands immediately adjacent to it in July and August of 2004. We expanded the project area, in this case, to ensure that wetlands immediately adjacent to the project area documented for planning purposes. The entire length of I-405 and SR-520 was visually surveyed by driving along the project area and wetlands were verified by on-site determinations. Existing wetland reports that were previously completed for portions of the project area were reviewed and the information was used in field verification. Wetland determinations are based on methods set forth in the Washington State Wetlands Identification and Delineation Manual (Ecology, 1997). All wetland area calculations are estimates based on a visual assessment and are not intended to be technically rigorous wetland delineations. Wetland functional assessments were completed using the Wetland Functions Characterization Tool for Linear Projects (WSDOT, 2000). Upon completion of the inventory, all wetland data was entered into the GIS layer that also included all wetlands verified by aerial photo interpretation. Methods follow Gersib et al. (2004) Part II, Step 3.

Results

Forty wetlands totally approximately 36 acres occur within or immediately adjacent to the project area and have potential to be adversely impacted by future construction projects. Thirty-six wetlands are primarily of natural origin, while four have been significantly altered to function as stormwater detention ponds. All are considered jurisdictional wetlands, including the detention ponds.

Table D-1 summarizes individual wetland site data. Wetland classification and ratings summarized in the table follow Brinson (1993), Ecology (1993) and the Cowardin, et al (1979). Following this table are the narrative field notes for each wetland identified within or immediately adjacent to the project area.

Table D-1. Summary of Wetland Resources Within the Project Area

Wetland Field ID	GIS ID	HGM Classification [1]	Cowardin Classification [2]	Ecology Category [3]	Approximate Size in Acres	DAU Code	Avoidance/Minimization Rank		
							Site Scale	Landscape	Overall
A	1899	DF	PFO	II	1.53	121	High	High	High
B	1679	RF	PFO	II	1.09	106	High	High	High
C	1900	DF	PFO	II	0.59	104	High	Moderate	Mod-High
D	1901	DC	PFO	II	0.77	77	High	Moderate	Mod-High
E	1902	DC	PEM	III	1.66	67	Moderate	Moderate	Moderate
F	1903	DC	PEM	III	0.74	18	Moderate	Moderate	Moderate
G	1904	DC	PEM	III	2.05	18	Moderate	Moderate	Moderate
H	1905	RF	PEM	II	3.71	18	High	High	High
I	1906	RF	PFO	II	4.97	15	High	Moderate	Mod-High
J	1907	RF	PFO	II	1.18	98	High	Moderate	Mod-High
K	1908	DC	PFO	II	0.54	121	High	High	High
L	1909	DC	PFO/PSS	II	2.19	77	High	Moderate	Mod-High
M	1910	RF	PFO	II	4.67	15	High	High	High
N	1911	DC	PFO	II	2.31	41	High	Moderate	Mod-High
O	1912	DC	PFO	III	0.8	98	Moderate	Low	Low-Mod
P	1913	DC	PEM	III	0.79	98	Moderate	Moderate	Moderate
Q	1914	DC	PEM	III	1.55	98	Moderate	Moderate	Moderate
R	1916	DC	PFO/PEM	Partial II & Partial III	4.54	98	High	Moderate	Mod-High
S	1917	DC	PEM	III	0.3	98	Low	Low	Low
T	1918	RF	PEM	III	0.58	98	Moderate	Moderate	Moderate
U	1919	RF	PEM	III	1.35	98	Moderate	Moderate	Moderate
V	1920	DC	PSS/PEM	III	0.28	105	Low	Low	Low
W	1921	DF	PFO/PSS/PEM	II	1.04	105	High	High	High
X	1922	DF	PFO/PSS/PEM	II	4.54	107	High	High	High
Y	1923	DF	PFO/PSS/PEM	II	4.04	96	High	High	High
Z	1924	DF	PEM	II	0.8	96	High	High	High

Wetland Field ID	GIS ID	HGM Classification [1]	Cowardin Classification [2]	Ecology Category [3]	Approximate Size in Acres	DAU Code	Avoidance/Minimization Rank		
							Site Scale	Landscape	Overall
AA	1925	DF	PFO/PSS/PEM	II	2.1	96	High	High	High
BB	1926	DC	PFO/PSS/PEM	III	16.84	83	Moderate	Moderate	Moderate
CC	623	DF	PFO/PSS/PEM	II	1.12	83	High	High	High
DD	1927	DC	None (Detention Pond)	None	0.3	86	Low	Low	Low
EE	1928	DC	None (Detention Pond)	None	0.42	86	Low	Low	Low
FF	1929	DC	PEM	III	4.19	86	Moderate	Moderate	Moderate
GG	1930	DC	PSS/PEM	III	6.08	86	Moderate	Moderate	Moderate
HH	1932	DC	None (Detention Pond)	None	0.54	59	Low	Low	Low
II	1933	DC	None (Detention Pond)	None	0.51	98	Low	Low	Low
JJ	1934	DC	PFO/PSS/PEM	III	9.78	95	Moderate	Moderate	Moderate
KK	1935	DC	PSS/PEM	II	2.8	97	High	Moderate	Mod-High
LL	1936	DF	PFO/PSS/PEM	II	0.84	97	High	High	High
MM	1915	DC	PFO/PSS/PEM	II	0.33	35	High	Moderate	Mod-High
NN	1937	DC	PFO/PSS/PEM	II	11.9	95	High	High	High

[1] A Hydrogeomorphic Classification for Wetlands (Brinson, 1993).

[2] Classification of wetlands (Cowardin, et al., 1979).

[3] Washington State Wetlands Rating System (Ecology, 1993).

PFO = Palustrine Forested wetland
PSS = Palustrine Scrub-Shrub wetland
PEM = Palustrine Emergent wetland
Ecology Category = Categories I through IV, where I is of the highest quality rank and IV is of the least quality rank

A tool specifically developed for evaluating wetland functions (WSDOT, 2000) was used to assess wetland functions. This assessment identified both principal and secondary functions of each wetland. Functions assessed include:

- Flood flow alteration
- Sediment retention
- Nutrient and toxic removal

- Erosion control and shoreline stabilization
- Production of organic matter and its export
- General habitat suitability
- Habitat for aquatic invertebrates
- Habitat for amphibians
- Habitat for wetland-associated mammals
- Habitat for wetland-associated birds
- General fish habitat
- Native plant richness

Wetlands In I-405 Corridor

Wetland A is a PFO depressional flow-through system located in the existing highway project area on the west side of the SE 8th exit in Bellevue. There is a culvert running along the road and just to the west of the wetland. Overstory consists of black cottonwood and alder. Shrubs include pacific willow and Himalayan blackberry. Reed canarygrass and common horsetails are the dominant herbs. Area is approximate 1.5 acres. Ecology Rating is a Category II. This can be considered a preservation site.

Wetland B is a PFO riverine flow-through system located just outside of the highway project area on the east side of SE 8th in Bellevue. Mercer Slough flows through this wetland, and there is a good deal of standing water under the Wilburton Trestle. Cottonwoods and alders are present along the slough, as well as Himalayan blackberries and Pacific willow. Herbs include reed canarygrass and common horsetails. This area intersects mapped hydric soils on the orthophoto. Area is approximate 1.1 acres. Ecology Rating is a Category II. This can be considered a preservation site.

Wetland C is a PFO depressional flow-through wetland in the southeast quadrant of NE 4th in Bellevue. Large black cottonwoods and some paper birch are present as well as Himalayan blackberries. There is a culvert at the south end of this wetland with water flowing through it, which is probably part of a ditch since there is no mapped stream that shows up on the GIS data. This area intersects mapped hydric soils on the orthophoto. Area is approximate 0.6 acres. Ecology Rating is Category II. This can be considered a preservation site.

Wetland D is PFO depressional closed wetland within the highway project area in the northeast quadrant of 116th Ave. in Redmond. Overstory consists of black cottonwood and alders, with Scouler willow, Sitka willow and Pacific willow, trailing blackberries and Douglas spire. Area is approximate 0.8 acres. Ecology Rating is Category II. Redoximorphic features were found in the soil at 12” indicating that this area is periodically inundated. This can be considered a preservation site and a good area for a swale (approximate 100 x 350 feet).

Wetland E is a PEM depressional closed system on the northeast side of NE 124th in Totem Lake, across from the mall. The dominant herb is reed canarygrass. Other vegetation includes Douglas spire, pacific willow, Himalayan blackberries, evergreen blackberries, alders, horsetails and climbing nightshade. Hydric soils are inundated to

the surface. Area is approximate 1.7 acres (approximate 100 x 800 feet). Ecology Rating is a Category III. This site appears to be functioning as a swale for runoff and can be considered a restoration site due to the large presence of reed canarygrass and fill added from construction of the highway.

Wetland F is a PEM depressional closed system in the northeast quadrant of the interchange at I-405 and SR 522. There are a few Lombardy poplars as well as soft rush, wood rush, curly dock, reed canarygrass and bent grass. Redoximorphic features are found in the soil at 12", even though this area was filled on the hydric soils that are mapped. Approximate area is 0.7 acres (approximate 100 x 600 feet). Ecology Rating is Category III. This can be considered a restoration site by removing the fill down to the original hydric soils.

Wetland G is much the same as Wetland F in that fill was placed over hydric soils. This wetland is located in the northwest quadrant of the I-405 and SR 520 Interchange. Vegetation is the same as in Wetland F. Approximate area is 2.0 acres. Ecology Rating is Category III. This can be considered a restoration site in the same way that Wetland F is described.

Wetland H is a PEM riverine flow-through system with North Creek flowing through it. The area surrounding the stream contains reed canarygrass, Himalayan blackberry and vine maple. The area nearest the office buildings contains paper birch, alders, hazelnut trees, Japanese knotweed and a large weeping willow. Redoximorphic features were found at 8". Approximate area is 3.7 acres. Ecology rating is Category II. The area near the office buildings has some restoration potential.

Wetland I is a PFO riverine flow-through wetland with Perry Creek as a part of it. Overstory contains black cottonwoods, western red-cedars and alder. Shrubs include Himalayan blackberry, pacific and Scouler willow, trailing blackberries and Sitka willow. Common horsetails are dominant herbs along with western buttercup. Approximate area is 5 acres. Ecology Rating is Category II. This area can be considered as a preservation site.

Wetland J is a PFO riverine flow-through system along Yarrow Creek just north of the I-405 and 520 interchange on the west side of 116th Ave. NE Vegetation consists of western red-cedar, black cottonwoods, alders, vine maple, Himalayan blackberries and Sitka willow. Approximate area is 1.2 acres (approximate 100 x 1200 feet). Ecology Rating is Category II. This area can be considered a preservation site.

Wetland K is a PFO depressional closed wetland with an overstory of black cottonwoods and alders. This wetland is just east of Wetland A and lies in the median. Shrubs include pacific willow, Scouler willow and Himalayan blackberry. There is some reed canarygrass and Japanese knotweed in the herbaceous layer. This wetland was most likely hydrologically connected with Wetland A prior to the construction of I-405. This wetland is surrounded on 3 sides by upland habitat. There are redoximorphic features in the soil within 12" of the surface. Approximate area is 0.5 acres. Ecology Rating is Category II. This area can be considered a preservation site.

Wetland L is a PFO/PSS depressional closed wetland just south of NE 116th in Redmond and on the east side of I-405. This is already a protected wetland by the city of Kirkland. The area in the highway project area is dominated by reed canary grass and includes some horsetails and soft rush. Just east of the highway project area is an area with soft rush, reed canarygrass, rib plantain and curly dock. In the area closest to the

road there are black cottonwoods, red alders, Scouler and pacific willow and Himalayan blackberries. This area ends at a small retaining wall fronting the road. A culvert enters the wetland at the south end, bringing runoff from the eastern side of the residential road. Approximate area is 2.2 acres. Ecology Rating is Category II. This area can be considered a preservation site.

Wetland M is a PFO riverine flow-through system on the southwest side of the I-405 and Mill Creek Interchange. A North-Creek Tributary flows through this wetland and the overstory contains western red-cedars, red alders and black cottonwood. Himalayan blackberries and vine maple are also present. This is already a protected wetland. Approximate area is 4.7 acres. Ecology Rating is Category II. This can be considered a preservation site.

Wetland N is a PFO depressional closed system. It is located just south of the NE 160th St. exit on the east side of I-405. This wetland contains black cottonwood, red alder, pacific willow, Himalayan and evergreen blackberries, soft rush and reed canary grass. Approximate area is 2.3 acres. Ecology Rating is Category II. This area can be considered a preservation site and a possible swale location.

Wetland HH is a jurisdictional 2-cell detention pond ½ mile north of 124th Street NE on I-405 southbound. Approximate area is 0.5 acres.

Wetland MM is a small PFO/PSS/PEM depressional closed wetland located just east of the I-405 northbound off-ramp to 160th Ave. NE. This wetland is within the highway project area. Vegetation consists of soft rush, curly dock, Himalayan blackberry, red alder, reed canarygrass, trailing blackberry and paper birch. Approximate area is 0.4 acres. Ecology rating is a Category II. Because of its small size and the limited area around it for potential restoration, this wetland is not recommended for project uses.

Wetlands In SR-520 Corridor

Wetland O is a PFO depressional closed system and is located on the north side of SR-520 near the NE 108th St. exit. There is a small wetland area in the bottom of this ravine that has numerous common horsetails in it. Other vegetation includes black cottonwoods and western red-cedars. The rest of the area is upland. Approximate area is 0.8 acres (approximate 50 x 700 feet). Ecology Rating is a Category III. This can be considered a preservation site and a possible location for a swale.

Wetland P is a PEM depressional closed system and lays in an area mapped with hydric soils. Most of this wetland was filled during the construction of SR-520. The vegetation includes Scouler willow, reed canarygrass, common horsetails and Himalayan blackberry. Approximate area is 0.8 acres. Ecology Rating is Category III. This area can be considered a restoration site when the fill is removed.

Wetland Q is much like Wetland P in that fill was added to an area with hydric soils. There are two large western red-cedars on the western edge of this area, and other vegetation includes pacific willow, one paper birch, Himalayan blackberry and reed canarygrass. Approximate area is 1.6 acres. Ecology Rating is Category III. This area can be considered a restoration site when the fill is removed.

Wetland R is located just south of the SR-520 on-ramp to 92nd Ave. NE near Medina. It is a PFO/PEM depressional closed wetland. Vegetation consists of black cottonwood, alder, western red-cedars, Himalayan blackberry, common horsetails, reed

canarygrass, soft rush and curly doc. Redoximorphic features in the soil range from 2" – 8" in depth. Approximate total area is 3.0 acres. Approximate forested area is 4.5 acres and approximate restoration area is 1.0 acres. Ecology rating for the forested area is Category II, and the rating for the emergent area is Category III. This area can be considered a partial preservation area (forested) and a partial restoration area (emergent and fill areas).

Wetland S is a PEM depressional closed system located just to the south of the SR-520 eastbound exit ramp to Bellevue Way. This wetland is dominated by reed canarygrass with a few Himalayan blackberries. Faint redoximorphic features are displayed from 6-12" in the soil. Approximate area is 0.3 acres (approximate 20 x 100 feet) . Ecology rating is a Category III. Because of its small size, this wetland is not recommended for project purposes.

Wetland T is a PEM riverine flow-through system south of the SR-520 westbound off-ramp to Bellevue Way. Vegetation consists of reed canarygrass with Stream 0252 running through it. Approximate area is 0.6 acres. Ecology Rating is a Category III. This can be considered an enhancement site.

Wetland U is a PSS/PEM riverine flow-through system south of the SR-520 eastbound off-ramp to Bellevue Way. Plants include reed canarygrass, nettle, cattail, yellow iris, Pacific willow and red elderberry. Approximate area is 1.4 acres. Ecology rating is a Category III. This can be considered an enhancement site.

Wetland V is a PFO/PSS/PEM depressional closed wetland located on the south side of SR-520 between 116th Ave. NE and the Burlington Northern Railroad. Currently the wetland is a small, forested band between the highway and a filled area. Plants include red alder, black cottonwood, Douglas spire, salmonberry, horsetail and lady fern. Approximate area is 0.3 acres. Ecology rating is a Category III. Because of its small size, this wetland is not recommended for project uses.

Wetland W is a PFO/PSS/PEM depressional flow-through wetland located on the north side of SR-520 and on the west side of the Burlington Northern Railroad. This wetland is a remnant of a larger, high quality system. Plants include red alder, black cottonwood, Douglas spiraea, twinberry, skunk cabbage, horsetail and lady fern. Approximate area is 1.0 acres and the Ecology rating is a Category II. This site can be considered a preservation area.

Wetland X is a PFO/PSS/PEM depressional flow-through system located on the south side of SR-520 and just west of 140th Ave. NE. This wetland is crossed on one end with a small, unnamed tributary to Valley Creek and is a narrow strip of land between SR-520 and urban development. Vegetation includes cattail, purple loosestrife, reed canarygrass, salmonberry, red alder, Nootka willow, Scouler willow, lady fern, black cottonwood, western red-cedar and skunk cabbage. Approximate area is 4.5 acres. Ecology Rating is a Category II. Because this site is so long and narrow, it is not recommended for project uses.

Wetland Y is a PFO/PSS/PEM depressional flow-through system located on the south side of SR-520 and just east of 140th Ave. NE. This wetland was most likely hydrologically connected to Wetland X before 140th was built. Vegetation includes red alder, black cottonwood, western red-cedar, red-osier dogwood, Pacific willow, Scouler willow, salmonberry, cattail, bulrush, forget-me-not, lady fern and skunk

cabbage. Approximate area is 4.0 acres. Ecology rating is a Category II. This site can be considered a preservation site.

Wetland Z is a PEM depressional flow-through system located at 136th Place NE on the north side of SR-520. This wetland was part of a larger system prior to development. Plants include reed canarygrass, cattail and salmonberry. Approximate area is 0.8 acres. Ecology rating is a Category II. This site can be considered a preservation site.

Wetland AA is a PFO/PSS/PEM depressional flow-through system just to the east of 140th Ave. NE on the north side of SR-520. This wetland exists along Valley Creek and an unnamed tributary. Vegetation includes red alder, black cottonwood, Nootka Willow, Scouler willow, twinberry, lady fern and forget-me-not. Approximate area is 2.1 acres. Ecology Rating is a Category II. This wetland is located inside of the highway project area and can be considered a preservation site.

Wetland BB is a PFO/PSS/PEM depressional closed wetland on the north side of SR-520 at the NE 51st St. interchange. It is part of a large system that forms the headwater for Stream 0104. Most of the site has been cleared and is heavily disturbed. Vegetation includes western buttercup, red alder, Lombardy poplars, rib plantain, reed canarygrass, slough sedge, black cottonwood, Scouler willow, piper willow soft rush and some Himalayan blackberry. Approximate area is 16.8 acres. Ecology rating is a Category III. This site can be considered an enhancement area.

Wetland CC is a PFO/PSS/PEM depressional flow-through system on the north side of SR-520 at Lake Sammamish Parkway. Vegetation includes black cottonwood, Scouler willow, common horsetails, curly doc, Pacific willow, rib plantain, reed canarygrass and Douglas spiraea. This wetland is located within the highway project area and the approximate area is 1.1 acres. The Ecology rating is a Category II. This site can be considered a preservation site.

Wetland DD is a jurisdictional 3-cell detention pond on the west side of the SR-520 and SR-202 interchange. Vegetation includes a few black cottonwoods, Himalayan blackberry around the perimeter, rib plantain, Pacific willow and reed canarygrass. Approximate area is 0.3 acres.

Wetland EE is a jurisdictional 2-cell detention pond on the west side of the SR-520 and SR-202 interchange. Vegetation includes a few black cottonwood, Himalayan blackberry around the perimeter, rib plantain, and reed canarygrass. Approximate area is 0.4 acres.

Wetland FF is a PEM depressional closed wetland that was partially filled to construct the overpass for SR-520 at SR-202 in the NE quadrant. Redoximorphic features in the soil are present at 3”-12” on the east side, and the old streambed has gleyed soils at 14”. No stream is now present. This site is approximate 4.2 acres and the Ecology rating is a Category III. This site can be considered a mitigation/restoration site because of the larger size. A significant amount of fill would need to be removed to restore the wetland.

Wetland GG is a PEM/PSS depressional closed wetland just south of Bear Creek between approximate ½ mile west of the SR-202 westbound on-ramp and Lake Sammamish Parkway exit ramp. This area exists within the highway project area. Vegetation consists mainly of reed canarygrass, willows and a few coast pines. Faint redoximorphic features are found in the soil at a depth of 12” upslope and strong fea-

tures are found at 4” near the vegetation change downslope. Fill could be removed to restore this wetland. Approximate area is 6.0 acres. Ecology rating is a Category III. This area can be considered an enhancement site.

Wetland II is a 2-cell detention pond located just before the 108th Street exit ramp on SR-520 westbound in Bellevue. Approximate area is 0.5 acres.

Wetland JJ is a PFO/PSS/PEM depressional closed system in Marymoor Park on the south side of SR-520 and just east of Lake Sammamish Parkway. Vegetation consists of reed canarygrass, curly dock, Himalayan blackberry, a few Lombardy poplars, black cottonwood, soft rush and a white poplar. Almost all of this wetland is in an area mapped with hydric soils. Approximate area is 9.8 acres. Ecology rating is a Category III. This area can be considered an enhancement site.

Wetland KK is a PSS/PEM depressional closed wetland along a small remaining portion of an unnamed stream course that traversed the gulch prior to the construction of SR-520. It is located where the Old Redmond Road nears SR-520. Vegetation includes reed canarygrass, red alder, soft rush, Scouler willow and purple loosestrife. Approximate area is 2.8 acres. Ecology rating is a Category II. This site can be considered a preservation site.

Wetland LL is a PFO/PSS/PEM depressional flow-through wetland on the north side of SR-520 and just east of 130th Ave. NE. Most of this wetland is within the highway project area. This wetland occurs along a portion of Geoff Creek, which provides its hydrology. Vegetation includes willows, red alder, black cottonwood, salmonberry, western red-cedar, twinberry, lady fern and nettles. A portion of the stream running north to south is confined with a gabion structure. Approximate area is 0.8 acres. Ecology rating is a Category II. This site can be considered a preservation site.

Wetland NN is a PFO/PSS/PEM depressional closed system located within Marymoor Park south of SR-520 and just east of 3 soccer fields. It is clearly marked with a fence around it and with posted wetland signs. Vegetation includes reed canarygrass, black cottonwood, Douglas spire, rib plantain, Nootka rose, cattails, vine maple, western crabapple and field mint. Approximate area is 12.0 acres. Ecology rating is a Category II. This site can be considered a preservation site.

Wetland Function Assessment

Watershed characterization for transportation projects provides practicable alternatives regarding wetland restoration and mitigation opportunities for flood flow attenuation, nutrient and toxicant removal and sediment removal, as well as habitat locations for wetland associated mammals and birds. The purpose of this step is to quantify the functions of regulated natural resources having a potential of direct impacts from the project (Gersib et al., 2004).

Methods

Wetland resources within the project area were assessed to determine the functions they provide. Methods follow Gersib et al. (2004).

Results

Assessment findings indicate that eighteen of the wetland sites within the estimated project area provide “Nutrient and Toxicant Removal” as a principle function, six wetlands provide “Habitat for Wetland-Associated Mammals” as a principal function,

and four wetlands provide “Flood Flow Alteration” as a principal function. Three wetlands provide “General Habitat Suitability” and three provide “Habitat for Wetland-Associated Birds” as a principal function. One wetland provides “Sediment Removal” and one provides “General Fish Habitat” as the primary function. The remaining four wetlands are jurisdictional detention ponds. The wetlands in the project area provide other secondary functions as well. Fourteen provide “Production of Organic Matter and its Export”, thirteen provide “Nutrient and Toxicant Removal” and twelve provide “Flood Flow Alteration”. Eleven wetlands provide “Habitat for Aquatic Invertebrates”, ten provide “Sediment Removal” and nine wetlands provide “General Habitat Suitability” as secondary functions. All wetlands, with the exception of the four detention ponds, provide numerous secondary functions based on their Ecology Category (Ecology, 1993), hydrogeomorphic classification (Brinson, 1993), and location on the landscape. Table D-2 refers to the principal functions of each wetland and lists their Ecology Category. Table D-3 presents the results of each individual site wetland function assessment.

Table D-2 Wetlands and Principal Functions

Wetlands	**Principal Function**	**Ecology Category**
B, C, D, KK, NN	Nutrient and Toxicant Removal	II
E, F, G, O, P, Q, S, T, BB, FF, GG, JJ	Nutrient and Toxicant Removal	III
R	Nutrient and Toxicant Removal	II & III
H, I, W, AA, CC, LL	Habitat for Wetland Associated Mammals	II
K, L, N	Flood Flow Alteration	II
U	Flood Flow Alteration	III
M, Y, Z	General Habitat Suitability	II
X, MM	Habitat for Wetland Associated Birds	II
V	Habitat for Wetland Associated Birds	III
A	Sediment Removal	II
J	General Fish Habitat	II

Table D-3 Functional Assessment of Wetlands Within the Project Area.

- Note: Letter denotes field ID and number denotes the GIS ID used on this project.
- X – This function is provided by the wetland
- **P** – Principal function provided by the wetland

Wetland Functions														

	A 1899	**B 1679**	**C 1900**	**D 1901**	**E 1902**	**F 1903**	**G 1904**	**H 1905**	**I 1906**	**J 1907**	**K 1908**	**L 1909**	**M 1910**	**N 1911**
Flood flow alteration	X					X	X		X		**P**	**P**	X	**P**
Sediment removal	**P**	X	X	X	X			X					X	
Nutrient and toxicant removal	X	**P**	**P**	**P**	**P**	**P**	**P**	X	X	X	X	X	X	X
Erosion control and shoreline stabilization		X	X					X	X	X			X	
Production of organic matter and it's export	X	X	X	X				X	X				X	
General habitat suitability		X							X	X	X		**P**	
Habitat for aquatic invertebrates	X	X			X			X	X				X	X
Habitat for amphibians	X								X				X	

Habitat for wetland-associated mammals	X	X	X					**P**	**P**	X			X	X
Habitat for wetland-associated birds								X					X	
General fish habitat										**P**				
Native Plant richness	X	X	X	X					X			X	X	
Educational or Scientific Value	X												X	
Uniqueness and Heritage														

	O 1912	**P 1913**	**Q 1914**	**R 1916**	**S 1917**	**T 1918**	**U 1919**	**V 1920**	**W 1921**	**X 1922**	**Y 1923**	**Z 1924**	**AA 1925**	**BB 1926**
Flood flow alteration				X			**P**		X	X	X			
Sediment removal		X	X			X			X					
Nutrient and toxicant removal	**P**	**P**	**P**	**P**	**P**	**P**	X		X				X	**P**
Erosion control and shoreline stabilization							X		X			X	X	

Production of organic matter and it's export			X				X		X			X	X	
General habitat suitability					X				X		**P**	**P**	X	
Habitat for aquatic inver-tebrates		X							X					
Habitat for amphibians	X													
Habitat for wetland-associated mammals									**P**			X	**P**	X
Habitat for wetland-associated birds								**P**	X	**P**	X	X		
General fish habitat						X	X		X					
Native Plant richness			X					X	X		X			X
Educational or Scientific Value														
Uniqueness and Heritage														

	CC 623	**DD 1927**	**EE 1928**	**FF 1929**	**GG 1930**	**HH 1932**	**II 1933**	**JJ 1934**	**KK 1935**	**LL 1936**	**MM 1915**	**NN 1937**
Flood flow alteration		Detention pond	Detention pond		X	Detention pond	Detention pond	X			X	

Sediment removal												
Nutrient and toxicant removal	X			**P**	**P**			**P**	**P**		X	**P**
Erosion control and shoreline stabilization	X									X		
Production of organic matter and it's export	X									X		
General habitat suitability									X	X		
Habitat for aquatic invertebrates										X	X	
Habitat for amphibians											X	X
Habitat for wetland-associated mammals	**P**									**P**	X	X
Habitat for wetland-associated birds										X	**P**	X
General fish habitat										X		
Native Plant richness	X									X		X

Educational or Scientific Value												
Uniqueness and Heritage												

Other Natural Resources

Methods

Information was compiled on the location and extent of aquatic and terrestrial natural resources within the project area. A series of GIS layers including riparian, floodplain resources, critical aquifer recharge areas, water bodies, surficial geology, hydrologic soil groups, geologically hazardous areas and FEMA 100-year flood plains were placed in a GIS file for analyses of impacts within the project area.

Results

Three acres of lake area, 36 acres of floodplains, and 34 acres of riparian habitat occur in the project area and have some potential to be impacted by new construction. A summary of aquatic resources within the project area is presented in Table D-4 and as an ArcMap file stored on the attached compact disk.

Table D-4: Summary of Resources Within the Project Area

Resources	Acres	Functions
Wetlands	18	Flood Flow Alteration, Sediment Removal, Nutrient and Toxicant Removal, Erosion Control and Shoreline Stabilization, Production of Organic Matter & Export, General Habitat Suitability, Habitat for Aquatic Invertebrates, Habitat for Wetland-Associated Mammals, Habitat for Wetland-Associated Birds, General Fish Habitat, Native Plant Richness, Educational or Scientific Value, Uniqueness and Heritage
Water bodies	3	Stormwater attenuation, sediment storage, fish habitat
Floodplains	36	Flood attenuation, habitat for fish, insects and wildlife, agricultural uses, aesthetic values, sediment control.
Riparian buffer 67 meters - forests	34	Habitat for wildlife, insects and fish, large woody debris recruitment, shade for streams, flood and sediment control.

Identify Potential Effects on Special Species and In the Highway Project Area Habitats

The proposed I-405 / SR-520 corridor widening project crosses a variety of stream systems supporting important fish and wildlife resources. In this section, we characterize the type and condition of fish habitats within streams crossing the project area and gain understanding into the types of habitats they provide.

While the identification of natural resources within a project area is possible, quantifying the direct impacts to these resources is not possible at this early stage of project planning.

Methods

Stream and river crossings within the I-405 project corridor were assessed to determine baseline conditions of the streams that could be affected through the widening of the existing I-405 SR-520 corridors. This information is necessary to determine potential impacts to fisheries resources in the project area. The stream reach assessments conducted were very general in nature. A detailed analysis will be conducted at the time of known highway project area needs following the selection of the preferred alternative.

Stream habitat conditions were evaluated on a catchment area scale and on a reach scale. The WSDOT Watershed Program Watershed Characterization completed provides information on the ecological condition of each catchment. In addition, King County, with multiple partners, has also completed a watershed level assessment of the catchments in the study area. While the WRIA 8 assessment was completed to assist the in recovery planning for Puget Sound chinook, the WRIA 8 results, as well as the results of the Watershed Characterization provide baseline conditions of the ecological condition of each stream catchment.

At the reach and site scale, various stream assessment methodologies were investigated to determine the appropriate methods for the information required for the watershed characterization of catchments in the project area. Following review of various methods, it was determined that the fisheries biologist completing the surveys of the stream crossings would use the Reach Level Assessment in the newly published “A Unified Stream Assessment: A Users Manual, published by the Center for Watershed Protection (Center for Watershed Protection, 2004). The manual includes standardized data collection sheets, as well as a detail description of methods, and additional database support that includes an Access program to input survey results. The results are numerical and thus provide an easy tool to assess each stream crossing, and then compare the results of each stream crossing to one another.

Results

The proposed I-405 / SR-520 corridor widening project has the potential to affect important fish and wildlife habitat based on information contained in the Priority Habitat Species (PHS) database, and reach level assessments (Center for Watershed Protection 2004) conducted by Kurt Buchanan, fisheries biologist for the Washington Department of Fish and Wildlife (WDFW). The PHS indicates that approximately 1.2 acres of Forbes Creek riparian habitat and approximately 1.3 acres of wetlands will be affected in the current highway project area, and approximately 9.8 acres of wetlands

in the North Creek catchment will be affected in the current highway project area. In addition, the reach level assessments conducted by WDFW staff indicate that Forbes Creek and North Creek contain high quality habitat based on Reach Level Assessments scores of 107 and 103, respectively. Forbes Creek is not identified by WDFW as supporting any PHS salmonid species, however, North Creek is identified as supporting runs of fall chinook, coho, and sockeye salmonid species.

The proposed project has the potential to affect fall chinook that are listed as threatened under the Endangered Species Act (ESA), as well as coho and sockeye. These salmonid species are also an important fisheries resource for local Native Tribes. The WRIA 8 Conservation Plan has assessed the stream and rivers in the study area through a Watershed Evaluation and Identification of Chinook Salmon Tier 1, 2, and 3 Subbasins Supporting Salmon Conservation Planning in WRIA 8 (Leonetti et al 2004). This was a landscape assessment, very similar to the work completed in this Watershed Characterization completed by the Watershed Program, WSDOT. In addition, the WRIA 8 Conservation Plan used the habitat based Ecosystem Diagnosis and Treatment (EDT) model, and developed a chinook salmon population matrix based on NOAA Fisheries Viable Salmonid Population attributes for populations (McElhany et al. 2000).

The proposed project has the potential to affect the following stream habitat in the following WRIA 8 catchments; West Lake Washington tributaries; Fairweather Creek, Cozy Cove Creek, Yarrow Creek, and Sturtevant Creek. Other tributaries in the I405 corridor include; Juanita Creek, Kelsey Creek and North Creek. All of the tributaries in the project corridor have been evaluated as having episodic to no chinook use, and have low watershed function, with the exception of Kelsey Creek and North Creek. Kelsey Creek was evaluated as having low watershed function, but is considered a satellite area, meaning that chinook do occupy the stream, but not on an annual basis. North Creek was evaluated to be a satellite area and has moderate watershed function. All the tributaries in the project corridor were categorized as Tier 3 priority subbasins, with the exception of North Creek, which was categorized as a Tier 2 priority subbasin. In addition, Kelsey Creek was elevated to a Tier 2 subbasin because of its higher than expected spawner abundance yet lower watershed condition.

Tier 3 subbasins have either lower watershed condition and significantly impaired watershed processes and degraded aquatic habitat and/or naturally limit production and abundance of chinook salmon based on subbasin size, channel width, gradient, or length of suitable habitat (Leonetti et al. 2004). In addition to limiting production of chinook, production of other salmon species appears to be limited as well.

In summary, the WRIA 8 Conservation Plan did not identify streams in the project corridor as having high aquatic value for salmonid species because of the highly urbanized and degraded areas where the project corridor is located. Conversely, subbasins, such as Bear Creek, and Issaquah Creek were classified as Tier 1 subbasins for chinook salmon, based on high fish use and higher watershed condition.

The I405/520 project will cross various streams in the project area. The following is a summary of the baseline conditions that would be affected by the proposed widening project.

Current Stream Conditions Within the SR-520 Project Area

The following are brief descriptions of current stream conditions within the SR-520 project area summarizing reach level assessments (Center for Watershed Protection 2004) conducted by Kurt Buchanan, fisheries biologist for the Washington Department of Fish and Wildlife:

Yarrow Creek at Yarrow Bay: Surrounding land-use around the crossing at Yarrow Creek consists of urban/residential, and a business park. Baseflow as percent of channel width, during the time of the survey was approximately 50-75 percent of channel width, but varied greatly. The dominant substrate was cobble, and heavy silt. Water clarity was clear. There were no attached or floating aquatic vegetation. The only evidence of wildlife usage was the presence of a garter snake. The riparian was mostly shaded, greater than 75 percent coverage. Instream habitat was marginal, with only 20-40 percent mix of stable habitat. While the riparian area was 70-90 percent native, invasive plants were present. The banks appeared to be stable and not eroding downstream, apparently because of a wetland complex downstream that is creating a backwater effect. However, upstream, there is evidence of downcutting, and active stream widening. The active floodplain in the area is accessible downstream, but upstream, high flows are presumed not able to enter the floodplain due to channel deepening. The overall buffer and floodplain condition is marginal, with little buffer, and encroachment in the form of filling, and subsequent land development. There is a fish passage barrier at the abandoned Lake Washington Blvd that is a 36-inch CMP with a four foot drop.

Cozy Cove Creek: Surrounding land-use at the crossing consists of urban/residential. Baseflow was 75-100 percent of channel width at the time of the survey (9/04). Dominant substrate was hardpan and mixed cobble and quarry spalls. Water was clear. A Remote Site Incubator (RSI) was located at the SR520 inlet. The assumption is that the RSI was spring fed. There was no floating or attached aquatic vegetation. There is no evidence that any fish or wildlife uses the stream. The riparian canopy consists of approximately 25 percent shading. The channel displays evidence of downcutting, bed scour, bank failure through scour upstream of the crossing and is rocked downstream. The overall condition of the stream is marginal to poor. There is no functioning floodplain.

Fairweather Bay Creek: Surrounding land-use is urban/residential. Base flow at the time of survey (9/04) was approximately 50-75 percent of channel width. The dominant substrate id gavel and silt upstream and cobble and riprap downstream. Water clarity was blackish. There were no attached vegetation and some floating duckweed. There were no signs of fish or wildlife use in the survey reach. The riparian canopy was mostly shaded, with approximately 75 percent shading. However, the vegetation was predominately exotic blackberry and ivy, with some trees. Downstream there exists a significant fish passage barrier under a private driveway and lawn culvert. The overall condition of the stream is poor to marginal.

Current Stream Conditions Within the I-405 Project Area

The following are brief descriptions of current stream conditions within the I-405 project area summarizing reach level assessments (Center for Watershed Protection 2004) conducted by Kurt Buchanan, fisheries biologist for the Washington Department of Fish and Wildlife:

Yarrow Creek at I405 Bellevue: Surrounding land use is commercial downstream and urban/residential upstream. Baseflow at the time of the survey (9/04) was 75-100 percent of channel width. Water clarity was clear. There were no attached or floating vegetation. There are signs of mountain beaver use by the presence of very large holes. The riparian canopy shades approximately 75 percent of the channel, however, the channel is incising and widening. The channel shows signs of bed scour, eroding stream banks, with bank failure. The overall condition of the stream is suboptimal to poor.

Forbes Creek at I405: Surrounding land use includes a forested environment with urban/residential uses. Baseflow at the time of the survey (9/04) was 50-100 percent of channel width. The dominant substrate is sand and gravel upstream, and compacted gravel downstream. Water quality was poor with tannins upstream and a slight milky color downstream. There were no floating or attached vegetation. There was evidence of fish and birds. The riparian canopy was mostly shaded. The channel upstream was in much better shape than the downstream channel that is downcutting and widening. The downstream bed is scoured, and the bank is eroding. The overall condition of the stream varies form optimal to marginal.

Kelsey Creek at I405 Bellevue: Surrounding land use is commercial and urban/residential, surrounded by freeway and major arterials. Baseflow the time of the survey (8/04) was 75-100 percent of the channel width. The dominant substrate is cobble, various sizes of shot rock, and silt. The water clarity was stained, and milky. There were some attached vegetation and no floating vegetation. The stream channel was 75 percent or more shaded. There were signs of fish and raccoon. The channel has been channelized and is downcutting. There are signs of bed scour and bank failure. The overall condition of the stream is suboptimal to poor.

Sturtevant Creek at I405 Bellevue: Surrounding land use is commercial and urban/residential. Baseflow at the time of the survey was 75-100 percent of channel width. The dominant substrate is gravel and cobble covered with thin fines. There were some floating duckweed and some attached vegetation. There were a few fish, but no other signs of wildlife. The stream was approximately 50 percent shaded. The channel is downcutting, widening, headcutting, with bed and bank scour, all in a channelized channel. The overall stream condition is marginal to poor.

Juanita Creek Tributary at Evergreen Hospital Medical Center: Surrounding land use in the vicinity includes commercial and urban residential. Baseflow at the time of the survey (8/04) was 50-75 percent of channel width. The dominant substrate is sand and gravel down stream and up stream some exposed hardpan and possible compressed peat. Water quality was clear upstream, while down stream was slightly turbid. There was no floating or attached vegetation, but nightshade was evident on the banks and within the stream. The channel upstream is downcutting and downstream aggrading with sand. The overall stream condition is marginal to poor.

Juanita Creek Tributary down from Kingsgate Park: The surrounding land use is park and forested. Baseflow at the time of the survey was 25-50 percent of the channel width. The dominant substrate is sand and silt. Water clarity was clear. There were no floating or attached vegetation. There was evidence of birds using the area. The riparian was mostly shaded at greater than 75 percent coverage. The channel is downcutting below the crossing, with signs of bed scour, and bank scour, while the

channel is aggrading above the crossing. The overall stream condition varies from optimal to poor.

Juanita Creek Tributary at I405 interchange with 124th: Surrounding land use is commercial. Baseflow at the time of the survey (8/04) was 75-100 percent of the channel width. The dominant substrate is muck and grass detritus. The water clarity was clear. There was lots of cattails and reed canary grass, with some floating duckweed. There was some evidence of bird use. The stream shading consisted of approximately 50 percent of the stream channel, because of the reed canary grass in the channel. The stream is channelized, and aggrading because of sediment deposition. The overall stream condition varies form optimal to poor.

Juanita Creek at 145th: Surrounding land use includes urban/residential downstream and a park upstream. Baseflow at the time of the survey (8/04) was 50-75 percent of the channel width. The dominant substrate is sand and compacted gravel. Water clarity was clear. There were no floating or attached vegetation. There were no signs of fish or wildlife use. The stream was shaded approximately 50 percent of the channel. The channel has been channelized, and is downcutting and widening downstream, with signs of bed scour and bank failure, while aggrading upstream in the channelized channel. The overall condition of the stream is marginal to poor.

North Creek Tributary (Tulley's Creek, also known as Perry Creek): Surrounding land use is suburban/residential and commercial. Baseflow at the time of the survey (8/04) was approximately 75-100 percent of the stream channel. Water quality was very good with lots of cool water. The dominant substrate is gravel, with signs of black embedded gravel. There was a 0+ salmon present, as well as signs of raccoon. The stream was mostly shaded at approximately 75 percent of the stream channel. The channel is downcutting. The overall condition of the stream is optimal to marginal.

North Creek Tributary (Park and Ride Creek) at I405/SR 527 Interchange: Surrounding land use ranges from forested to industrial. Baseflow at the time of the survey (8/04) was 25-50 percent of channel width. Water clarity was clear. There were no floating or attached vegetation. There was no evidence of fish or wildlife. The stream was mostly shaded covering approximately 75 percent of the channel. The channel shows signs of downcutting, bed scour, and bank scour. The overall condition of the stream varies from optimal to poor.

North Creek at I405 Bridge Crossing: Surrounding land use consists of urban/residential. Baseflow at the time of the survey (8/04) was 75-100 percent of the channel. The dominant substrate is silt and clay, with cobble. Water clarity was clear. There were some attached vegetation and no floating vegetation. There were signs of fish and past beaver activity. The stream is 75 percent shaded by the bridge. The channel has been channelized and armored. The overall condition of the stream is very poor under the bridge, but ranges from suboptimal to poor upstream and downstream of the bridge.

Sammamish River at multiple I405/SR520 Structures: The surrounding land use is a park and highways. Baseflow at the time of the survey was 75-100 percent of the channel. The dominant substrate is silt and clay, with shot rock lining. Water clarity was turbid, with suspended plankton. There were some floating and attached vegetation. Wildlife in the area included a swallow nest on the bridge and a heron. Stream

shading varies throughout the day based on the suns position, but is no more than 25 percent at any time. The channel has been channelized and has sediment deposition. The overall condition of the river is marginal to poor.

Table D-5 shows the results of a reach level assessment. Condition scores presented in this table are grouped into the following condition ranks: <50 = poor, 50-100 = Fair, and >100 = good.

Table D-5. Reach Level Assessment.

Site ID	Date	Catchment	Start	End	Sub-Total In-Stream Condition	Buffer/ Floodplain	Total Survey
1	9/10/2004	Yarrow Creek / Yarrow Bay	u/s of abandon LK WA BLVD us/ of SR-520	d/s outlet at Points Drive	31	53	84
2	9/10/2004	Cozy Cove Creek	d/s 520 crossing at Hunts Pt Lane		17	14	31
3	9/10/2004	Fairweather Bay Creek	us/ inlet to abandoned st end NE 28th St Medina	d/s of SR-520 outfall past trail footbridge	25	20	45
4	9/2/2004	Yarrow Creek at I-405 Bellevue	u/s at 116th	d/s at 115st Bellevue Service yard	31	53	84
5	9/1/2004	Forbes Creek	at confluence of 2 tribs on farm u/s on E of row	d/s of row fence, u/s beehive and culvert	46	61	107
6	8/13/2004	Kelsey Creek trib to Lk WA	100' u/s of I-405 NB off ramp - Bellevue	Mercer Slough d/s end of newer fishway to Lk WA	48	33	81
7	8/13/2004	Sturtevant Creek trib to Lk WA	100' d/s outlet 114th Ave SE	Parking lot at Bellevue Police dept	24	15	39
8	8/23/2004	Juanita Creek Tributary at Evergreen Hospital Medical center	u/s of Totem Lake Blvd	d/s @Woodlake Apts (116 and 132)	41	28	69
9	8/23/2004	Juanita Creek Tributary down from Kingsgate Park	d/s from Helen Keller school u/s to I-405 r/d/pond	u/s through Kingsgate Park@ NE 140th	17	30	47
10	8/23/2004	Juanita Creek Tributary at I-405 interchange with 124th	At McDonalds & 116th d/s of I-405	inlet at Yuppie pawn	47	30	77
11	8/27/2004	Juanita Creek at 145th	u/s includes a r/d pond	d/s of 145^{th} and abandoned cmp	40	28	68
12	8/10/2004	North Creek /Tulley Creek	Stream in between storage yard and shopping center	noise wall d/s of I-405	55	48	103

Site ID	Date	Catchment	Start	End	Sub-Total In-Stream Condition	Buffer/ Floodplain	Total Survey
13	8/10/2004	North Creek Tributary at I-405/SR-527 interchange	SR-527 inlet NB on ramp	100' u/s of 1-405 fence	42	47	89
14	8/11/2004	North Creek at I-405 Bridge Crossing	100' d/s I-405 North Creek bridge	100' u/s I-405 North Creek bridge	43	25	68
15	8/11/2004	Sammamish River at multiple I-405/ SR-520 structures	U/S of I-405/ SR-522 EB structure	d/s SB I-405 structure	24	10	34

Notes:

<50 = poor

50-100 = Fair

>100 = good

Quantify Contributing Areas for Stormwater Discharges

Stormwater mitigation is required for each water body that receives runoff from the project area. In this step we identify the project areas that discharge to receiving waters in the study area.

Methods

The project area coverage was overlaid onto the Drainage Analysis Unit (DAU) map to identify the total project acres within each DAU. WSDOT's 2003 Highway Log was used to calculate current (pre-project) impervious areas using the roadway and shoulder widths. Where impervious areas for the interchanges were not explicitly identified, aerial photography was used to estimate those areas and generally amount to 8 acres for a cloverleaf and 5 acres for a double diamond interchange. In the SR-405/Kirkland Nickel and SR-520 Evergreen Point Bridge project areas, the preliminary design reports were used to quantify pre and post project impervious areas. For those segments of I-405 and SR-520 where a preferred alternative have yet to be determined, it was assumed that a single 11 foot wide lane is added in each direction. Detailed methods follow Gersib et al. (2004) Part II, Step 7A.

Results

Table D-6 summarizes the I-405 and SR-520 project areas and receiving waters within each DAU. The I-405 project passes through the lower North Creek catchment before crossing the Sammamish River floodplain. The project then intersects three headwater forks of Juanita Creek and the upper portions of Forbes and Yarrow Creeks. Project areas between Forbes and Yarrow Creeks drain into urban drainage systems that flow directly to Lake Washington. The southern section of the project crosses the Sturtevant and Kelsey Creek catchments just upstream of Mercer Slough.

Table D-6. Total Project Areas and Impervious Areas for each Drainage Analysis Unit.

Drainage Analysis Unit	Catchment	Highway Project	Total Project Area (ac)	Project Impervious Areas (acres)		
				Existing Highway	New Areas added by Project	Total Post-Project
14	North Creek	405	79	23.1	6.1	29.2
15	North Creek	405	63	31.5	8.3	39.8
18	North Creek	405	113	57.3	14.3	71.6
35	Sammamish River	405	65	31.8	2.2	34.0
36	Sammamish River	405	9	5.3	0.4	5.7
41	Juanita Creek-Northern tributaries	405	18	6.8	0.6	7.4
59	Juanita Creek-Northern tributaries	405	49	28.2	2.6	30.8
58	Juanita Creek-Tributary #238	405	3	3.1	0.0	3.1
67	Juanita Creek-Totem Lake tributary	405	28	16.4	1.2	17.6
681	Juanita Creek-Totem Lake tributary	405	24	13.8	1.3	15.1
77	Forbes Creek	405	61	26.2	17.2	43.4
80	Lake Washington - Kirkland	405	84	48.1	9.2	57.3
98	Yarrow Creek	405	114	62.2	2.3	64.5
104	Sturtevant Creek	405	27	18.4	3.2	21.6
106	Kelsey-Mercer Creek	405	15	13.3	1.4	14.7
101	Lake Washington South	520 west	33	16.9	10.1	27.0
98	Yarrow Creek	520 west	22	12.4	9.8	22.2
98	Yarrow Creek	520 east	36	16.3	3.9	20.2
105	West Tributary Kelsey	520 east	27	17.3	4.0	21.3
107	Upper Kelsey Creek	520 east	1	0.7	0.1	0.8

Drainage Analysis Unit	Catchment	Highway Project	Total Project Area (ac)	Project Impervious Areas (acres)		
				Existing Highway	New Areas added by Project	Total Post-Project
97	Goff Creek	520 east	6	3.5	0.8	4.3
96	Valley Creek	520 east	37	26.2	2.8	29.0
108	Sears Creek	520 east	44	19.1	4.2	23.3
83	Sammamish River	520 east	73	39.1	8.3	47.4
95	Sammamish River	520 east	9	7.9	1.4	9.3
TOTAL			**1039**	**545**	**116**	**661**

West of I-405 the SR 520 project crosses Fairweather Creek, Cozy Cove Creek, and Yarrow Creek. East of I-405 the SR 520 project crosses the West Tributary of Kelsey Creek. The highway then traverses upward through the Kelsey Creek catchment, intersecting the Goff, Valley, and Sears Creek subcatchments. It drops into the Sammamish River valley and crosses the Sammamish River just upstream of Bear Creek. The highway runs parallel to the lower reaches of Bear Creek, but all stormwater runoff is directed into the Sammamish River.

Table D-7 compares the new impervious areas added by the projects to the existing impervious areas in each major catchment. The total project area is 1,039 acres, and includes 545 acres of existing pavement and 116 acres of new impervious area. The new impervious areas will increase the Total Impervious Area of the impacted catchments by 0.2 percent.

Table D-7. Project Impacts to Impervious Areas within each Catchment.

Project	Catchment	Drainage Area (acres)	Existing Total Impervious Area (TIA, acres)	Project Area (acres)	New Impervious Area added by Project (acres)	Catchment TIA before project	Catchment TIA after project	Increase in Catchment TIA due to project
I-405	North Creek	18311	7476	255	28.7	40.83%	40.99%	0.16%
	Areas that drain directly to the Sammamish River (excluding major tributaries and Lake Sammamish)	16567	6603	75	2.6	39.86%	39.87%	0.02%
	Juanita Creek	4186	2006	123	6.0	47.91%	48.06%	0.14%
	Forbes Creek	1836	815	61	17.3	44.41%	45.35%	0.94%
	Lake Washington - Kirkland	2602	1416	84	9.2	54.43%	54.78%	0.35%
	Yarrow Creek	1859	682	114	2.3	36.70%	36.83%	0.12%
	Sturtevant Creek	773	521	27	3.2	67.46%	67.87%	0.41%
	Kelsey and Richards Creeks	9046	4184	15	1.4	46.26%	46.27%	0.02%
SR 520 West, 6-lane alt.	Lake Washington South	3407	1586	33	10.1	46.54%	46.84%	0.30%
	Yarrow Creek	1859	682	22	9.8	36.70%	37.23%	0.53%
SR 520 East	Yarrow Creek	1859	682	36	3.9	36.70%	36.91%	0.21%
	Kelsey Creek	6799	3052	114	11.9	44.89%	45.07%	0.18%
	Areas that drain directly to the Sammamish River (excluding major tributaries and Lake Sammamish)	16567	6603	82	9.7	39.86%	39.92%	0.06%
Total For Impacted Catchments		**58587**	**25290**	**1039**	**116.0**	**43.17%**	**43.37%**	**0.20%**

Estimate Effects to Water Quality

Plans and preliminary designs are being developed for improvements of SR-405 and SR-520 east of Lake Washington. Two projects have funding available to complete environmental documentation and preliminary designs, the SR-520 Evergreen Point Floating Bridge replacement, which includes expansion of both the east and west approaches to the bridge, and the SR-405 Kirkland “Nickel” project, which will expand certain segments of I-405 in the Kirkland area. Other highway segments where projects are anticipated are I-405 from Bellevue to Kirkland, I-405 from Kirkland to Bothell, I-520 from I-405 to SR-202, and the SR-520 - SR202 interchange. Both SR-520 and I-405 were originally constructed in the 1960s. During those times, stormwater regulations had not yet been established, therefore both highways were con-

structed without any water quality treatment facilities integrated into the drainage designs. Highway geometrics and drainage systems were designed almost exclusively to convey runoff from the highway surface as efficiently as possible, since ponded stormwater on highways were, and still are, considered significant driving safety concerns. A series of limited-scale improvement projects have since added a few stormwater management facilities to WSDOT's drainage system. Both SR-520 and I-405 are both needing significant improvements to account for structure deterioration and to improve traffic capacity. Outside of the two projects mentioned above, funding is not currently available to initiate improvements on other sections of SR-520 or I-405 within the project area.

Methods

Measuring and evaluating the water quality impacts of SR 520 and SR 405 depends on the size of the hydrologic units used to calculate impacts. Stormwater management can produce the following types of downstream benefits: reduced frequency, area, and impact of flooding; less costly public drainage infrastructure, reduced pollution treatment needs (particularly for combined sewer systems); reduced erosion and sedimentation; improved water quality; improved in-stream biological integrity and aesthetics; and increased groundwater storage. To account for current regulatory restrictions imposed by Ecology on the available areas that can be used for stormwater flow attenuation, WSDOT's Watershed Management Program funded development of "drainage analysis units" (DAUs) within the SR 520 / I-405 project area. The DAUs, which range from 202 to 1978 acres in size, are roughly the size of 7th-tier (USGS) hydrologic unit codes. To be considered as potential candidates for mitigation of flow impacts from highway improvement projects, the mitigation site must be located upgrade topographically from the highway impacts and must be within the same DAU. At this time (10/04) regulators require that water quality impacts must to be mitigated at the point(s) of impact. Only 22 of the 185 DAUs and 3 of the 8 subareas will be potentially affected by improvements to SR-520 or I-405 within the watershed characterization area. King County Department of Natural Resources had previously developed much larger scale landscape-based hydrologic units which they call "subareas". These subareas range from 9,663 to 38,628 acres and are composed of several DAUs.

The non-point source pollutant loads from DAUs and subareas have been calculated for all hydrologic units that could be affected by improvements to SR 405 and 520 using the Long-Term Hydrologic Impact Assessment model (L-THIA, located at http://www.ecn.purdue.edu/runoff/index.html). L-THIA was developed as a straightforward analysis tool that provides estimates of changes in runoff, recharge and non-point source pollution resulting from past or proposed land use changes. It gives long-term average annual runoff for a land use configuration, based on actual long-term climate data for that area. By using many years of climate data in the analysis, L-THIA estimates the average impact over a daily 30 year rainfall record, rather than an extreme year or storm. L-THIA modeling results does not and cannot predict what will happen in any specific year or specific precipitation event. For peak and flow/duration simulations, an HSPF-based model would be needed. However, the currently available HSPF-based models available in Washington have a maximum watershed area of 250 acres, making them unsuitable for estimating flow and pollution impacts over DAU-scale watersheds. As a quick and easy approach, L-THIA re-

sults are intended to provide insight into the relative hydrologic impacts of different land use scenarios.

Five non-point source runoff parameters were modeled using L-THIA in the DAUs affected by potential I-405 or SR-520 improvements:

Total Annual Flow Volumes – This is the dominant parameter that influences long-term pollutant loading estimates since it is used as a multiplier with event mean concentrations for all loading estimates.

Total Phosphorous – This is considered the limiting nutrient in most aquatic systems since atmospheric deposition of nitrogen is ubiquitous throughout all watersheds. For highway runoff, monitoring studies have indicated that this parameter has significant statistical uncertainty when correlated to average daily traffic (ADT) statistics. Trends tend to indicate that phosphorous concentrations in highway runoff is somewhat inversely proportional to ADT, but the relationship is not statistically significant.

Total Suspended Solids – TSS is the most commonly analyzed parameter in the history of non-point source water quality monitoring. Many other pollutants are transported by suspended solids, so TSS loading is a good general parameter for estimating overall pollutant loading on watershed scales. The correlation between highway ADT and TSS event mean concentrations is very strong throughout the country, therefore TSS estimates determined in the analysis should be considered the most reliable of the suite of parameters analyzed.

Total Zinc – Zinc is a very common metal in all urban environments, and is an essential nutrient at low concentrations, but can also exhibit chronic or acute toxicity at higher concentrations. Highways tend to have higher EMCs for zinc than other land uses due to the prevalence of galvanized steel in automobiles and other metallic appurtenances used in highway construction (guard rails, manhole covers, etc.)

Fecal Coliform – FC has historically been the most common bacteria characteristic analyzed in freshwater systems. Fecal streptococcus is now considered a more reliable indirect indicator of the potential for pathogens, but the amount of monitoring data for multiple land uses is still sparse. FC is characteristically very highly variable between and within individual runoff events for all land uses, including highways. For this reason, the estimates of FC loading should be considered the least statistically reliable of the suite of parameters evaluated in this study.

Assumptions:

- Rain on snow events are discounted
- No reduction of flow volumes by infiltration basins, low impact development or
- Point source contributions to overall pollutant loadings are not included
- Flow Impacts of I-405 / SR-520 expansions on DAU-scale watersheds

Results

The estimated incremental impacts of SR-405 and SR-520 to overall flow and pollutant loading impacts are quantified in Table D-8. Flow volumes are completely dependent on land cover and soil types within the DAU. A key assumption is that there are no water losses from infiltration basins.

Table D-8. Non-Point Source Annual Flow Volume Impacts in the I-405 / SR-520 Project Area.

DAU	Drainage Basin	Net Annual Flow Volume/Unit Area (ac-ft/ac)	SR Annual Flow Volume/Unit Area (ac-ft)	I-405 / SR-520 contribution
14	North Cr.	0.55	0.028	5.0 percent
15	North Cr.	0.38	0.021	5.6 percent
18	North Cr.	0.44	0.033	7.6 percent
35	Sammamish R.	1.08	0.170	15.7 percent
36	Sammamish R.	0.32	0.015	4.6 percent
41	Juanita Cr.	0.70	0.058	8.3 percent
58	Juanita Cr.	0.86	0.015	1.8 percent
59	Juanita Cr.	0.67	0.132	19.5 percent
67	Juanita Cr.	0.70	0.053	7.6 percent
68	Sammamish R.	0.98	0.030	3.1 percent
77	Forbes Cr.	0.71	0.002	0.3 percent
80	L. Washington	0.90	0.073	8.1 percent
83	Sammamish R.	0.91	0.072	7.9 percent
95	Sammamish R.	0.73	0.037	5.0 percent
96	Kelsey-Mercer	0.62	0.043	7.0 percent
97	Kelsey-Mercer	0.65	0.012	1.8 percent
98	Yarrow Cr.	0.75	0.097	12.9 percent
104	Sturtevant Cr.	1.30	0.054	4.1 percent
105	Kelsey-Mercer	0.82	0.041	5.1 percent
106	Kelsey-Mercer	0.59	0.042	7.1 percent
107	Kelsey-Mercer	0.94	0.002	0.2 percent
108	Kelsey-Mercer	1.21	0.060	4.9 percent
Mean/All DAUs		0.75	0.046	6.2 percent

Watershed-Scale Pollutant Impacts of I-405 / SR-520 Improvements

It should be noted that the pollutant loading analysis (summarized in Tables D-9 through D-13) assumed that there was no water quality treatment provided for any of the non-point source runoff. This results in very conservative estimates of pollutant loading, particularly compounded with the assumption of no infiltration losses for flow volumes.

Table D-9. Non-Point Source Annual Phosphorous Loadings in the I-405 / SR-520 Project Area.

DAU	Drainage Basin	Net Annual P Loading/Unit Area (lbs/ac)	SR Annual P Loading/Unit Area (lbs/ac)	I-405 / SR-520 contribution
14	North Cr.	0.73	0.024	3.3 percent
15	North Cr.	0.49	0.020	4.1 percent
18	North Cr.	0.64	0.034	5.3 percent
35	Sammamish R.	1.40	0.153	10.9 percent
36	Sammamish R.	0.36	0.010	2.9 percent
41	Juanita Cr.	0.96	0.052	5.4 percent
58	Juanita Cr.	1.33	0.013	1.0 percent
59	Juanita Cr.	0.92	0.120	13.0 percent
67	Juanita Cr.	0.91	0.052	5.7 percent
68	Sammamish R.	1.15	0.027	2.3 percent
77	Forbes Cr.	0.97	0.030	3.1 percent
80	L. Washington	1.20	0.064	5.3 percent
83	Sammamish R.	1.26	0.083	6.6 percent
95	Sammamish R.	1.10	0.047	4.2 percent
96	Kelsey-Mercer	0.83	0.045	5.5 percent
97	Kelsey-Mercer	0.68	0.012	1.8 percent
98	Yarrow Cr.	0.91	0.086	9.4 percent
104	Sturtevant Cr.	1.50	0.046	3.0 percent
105	Kelsey-Mercer	1.02	0.042	4.1 percent
106	Kelsey-Mercer	0.72	0.042	5.9 percent
107	Kelsey-Mercer	1.28	0.001	0.1 percent

108	Kelsey-Mercer	1.62	0.065	4.0 percent
Mean/All DAUs		0.98	0.047	4.8 percent

Table D-10: Non-Point Source Annual Total Suspended Solids (TSS) Loadings in the I-405 / SR-520 Project Area Without Water Quality Treatment.

DAU	Drainage Basin	Net Annual TSS Loading/Unit Area (lbs/ac)	SR Annual TSS Loading/Unit Area (lbs/ac)	I-405 / SR-520 contribution
14	North Cr.	58.1	4.2	7.3 percent
15	North Cr.	46.0	6.2	13.5 percent
18	North Cr.	62.9	8.9	14.2 percent
35	Sammamish R.	177.8	59.5	33.5 percent
36	Sammamish R.	32.9	4.7	14.3 percent
41	Juanita Cr.	91.7	19.4	21.2 percent
58	Juanita Cr.	106.2	4.8	4.5 percent
59	Juanita Cr.	112.4	48.4	43.0 percent
67	Juanita Cr.	98.4	17.0	17.3 percent
68	Sammamish R.	128.9	10.4	8.0 percent
77	Forbes Cr.	91.6	12.7	13.8 percent
80	L. Washington	133.2	26.8	20.1 percent
83	Sammamish R.	117.6	15.4	13.1 percent
95	Sammamish R.	117.3	5.7	4.2 percent
96	Kelsey-Mercer	79.3	11.3	14.2 percent
97	Kelsey-Mercer	66.2	3.0	4.5 percent
98	Yarrow Cr.	107.2	35.9	33.5 percent
104	Sturtevant Cr.	193.5	20.4	10.5 percent
105	Kelsey-Mercer	109.8	11.4	10.4 percent
106	Kelsey-Mercer	67.7	11.6	17.1 percent
107	Kelsey-Mercer	124.5	0.5	0.4 percent
108	Kelsey-Mercer	184.8	14.4	7.8 percent

DAU	Drainage Basin	Net Annual TSS Loading/Unit Area (lbs/ac)	SR Annual TSS Loading/Unit Area (lbs/ac)	I-405 / SR-520 contribution
Mean/All DAUs		101.3	15.3	15.1 percent

Table D-11. Non-Point Source Annual Total Zinc (TSS) Loadings in the I- 405 / SR-520 Project Area Without Water Quality Treatment.

DAU	Drainage Basin	Net Annual Zinc Loading/Unit Area (lbs/ac)	SR Annual Zinc Loading/Unit Area (lbs/ac)	I-405 / SR-520 contribution
14	North Cr.	0.111	0.014	12.1 percent
15	North Cr.	0.093	0.014	14.6 percent
18	North Cr.	0.105	0.018	17.1 percent
35	Sammamish R.	0.389	0.135	34.6 percent
36	Sammamish R.	0.054	0.010	19.3 percent
41	Juanita Cr.	0.175	0.037	21.1 percent
58	Juanita Cr.	0.201	0.009	4.3 percent
59	Juanita Cr.	0.228	0.100	43.6 percent
67	Juanita Cr.	0.223	0.034	15.4 percent
68	Sammamish R.	0.313	0.023	7.3 percent
77	Forbes Cr.	0.198	0.030	15.0 percent
80	L. Washington	0.311	0.064	20.5 percent
83	Sammamish R.	0.241	0.028	11.6 percent
95	Sammamish R.	0.222	0.007	3.3 percent
96	Kelsey-Mercer	0.169	0.022	13.2 percent
97	Kelsey-Mercer	0.159	0.004	2.8 percent
98	Yarrow Cr.	0.237	0.083	35.1 percent
104	Sturtevant Cr.	0.511	0.047	9.1 percent
105	Kelsey-Mercer	0.264	0.023	8.7 percent
106	Kelsey-Mercer	0.118	0.023	19.7 percent
107	Kelsey-Mercer	0.285	0.001	0.3 percent

108	Kelsey-Mercer	0.422	0.023	5.4 percent
Mean/All DAUs		0.222	0.033	15.0 percent

Table D-12. Non-Point Source Annual Fecal Coliform (FC) Loadings in the I-405 / SR-520 Project Area Without Water Quality Treatment.

DAU	Drainage Basin	Net Annual FC Loading/Unit Area (MCol/ac)	SR Annual FC Loading/Unit Area (MCol/ac)	I-405 / SR-520 contribution
14	North Cr.	1067.4	23.6	2.2 percent
15	North Cr.	699.7	18.2	2.6 percent
18	North Cr.	795.4	28.2	3.5 percent
35	Sammamish R.	1823.8	145.1	8.0 percent
36	Sammamish R.	505.3	12.6	2.5 percent
41	Juanita Cr.	1427.2	49.4	3.5 percent
58	Juanita Cr.	1993.6	13.1	0.7 percent
59	Juanita Cr.	1322.1	112.7	8.5 percent
67	Juanita Cr.	1262.9	45.5	3.6 percent
68	Sammamish R.	1490.6	25.9	1.7 percent
77	Forbes Cr.	1402.0	28.9	2.1 percent
80	L. Washington	1655.8	62.3	3.8 percent
83	Sammamish R.	1737.5	61.3	3.5 percent
95	Sammamish R.	1242.7	31.3	2.5 percent
96	Kelsey-Mercer	1163.0	37.1	3.2 percent
97	Kelsey-Mercer	983.4	10.3	1.0 percent
98	Yarrow Cr.	1276.4	83.0	6.5 percent
104	Sturtevant Cr.	1844.3	45.7	2.5 percent
105	Kelsey-Mercer	1387.1	35.4	2.6 percent
106	Kelsey-Mercer	963.0	35.8	3.7 percent
107	Kelsey-Mercer	1737.4	1.5	0.1 percent
108	Kelsey-Mercer	1943.9	50.8	2.6 percent

Mean/All DAUs	1330.5	41.9	3.1 percent

Table D-13 - Incremental I-405 / SR-520 Impacts on Flow and Pollutant Loadings

	Percent I-405 / SR-520 Impacts on Total Loadings in the DAU				
DAU	Flow Volume	Phosphorous	TSS	Zinc	Fecal Coliform
14	5.0	3.3	7.3	12.1	2.2
15	5.6	4.1	13.5	14.6	2.6
18	7.6	5.3	14.2	17.1	3.5
35	15.7	10.9	33.5	34.6	8.0
36	4.6	2.9	14.3	19.3	2.5
41	8.3	5.4	21.2	21.1	3.5
58	1.8	1.0	4.5	4.3	0.7
67	7.6	5.7	17.3	15.4	3.6
68	3.1	2.3	8.0	7.3	1.7
77	4.8	3.1	13.8	15.0	2.1
80	8.1	5.3	20.1	20.5	3.8
83	7.9	6.6	13.1	11.6	3.5
95	5.0	4.2	4.2	3.3	2.5
96	7.0	5.5	14.2	13.2	3.2
97	1.8	1.8	4.5	2.8	1.0
98	12.9	9.4	33.5	35.1	6.5
104	4.1	3.0	10.5	9.1	2.5
105	5.1	4.1	10.4	8.7	2.6
106	7.1	5.9	17.1	19.7	3.7
107	0.2	0.1	0.4	0.3	0.1
108	4.9	4.0	7.8	5.4	2.6
High	15.7	10.9	33.5	35.1	8.0
Low	0.2	0.1	0.4	0.3	0.1

Mean	6.5	4.8	15.1	15.0	3.1
Median	5.3	4.2	13.7	13.9	2.6

Interpretation and analysis of flow and pollutant loading in the I-405 / SR-520 project area

The estimated I-405 / SR-520 impacts on flow and pollutant loading were, as expected, highly variable between DAUs. The DAUs exhibited significant variations in land cover and minor variations in soil composition, which resulted in corresponding and proportional effects on flow volumes. The land cover in the DAUs ranged from diffuse suburban land uses (North Creek) to very highly urbanized landscapes (Sturtevant Creek, in downtown Bellevue). For all DAUs, the incremental contribution of fecal coliform loading by state highways were very small, all less than 8 percent and generally less than 4 percent. Phosphorous loadings were also consistently displayed very low incremental loadings for state highways, with only one DAU (35) exceeding 10 percent. Both TSS and zinc showed significantly higher incremental contributions to DAU-scale loadings in all cases. DAUs 35 and 98 showed unusually high flow and pollutant loading for all parameters. This is due to large incremental impervious footprints for the highways in those DAUs: DAU 35 (Sammamish River) includes two large interchanges, including the SR 405/522 I/C and DAU 98 (Yarrow Creek) includes impacts from both SR 405, SR 520 and their interchange.

Estimate Effects to Water Quantity

Ecology's stormwater regulations require projects to mitigate for increases in the magnitude and duration of stormwater flows. Methods from the Highway Runoff Manual were used to estimate project impacts to stormwater flows, and to identify stormwater flow control mitigation needs.

Methods

We quantified project flow impacts by simulating runoff from the project areas with WSDOT's MGSFLOOD model. MGSFLOOD is a continuous rainfall-runoff model that simulates hourly runoff from paved, landscaped, pastured, and forested land covers. The model sizes storage and infiltration facilities for stormwater mitigation.

WSDOT's Highway Runoff manual requires impacts to be defined relative to a pre-developed land cover. In non-urban areas the default assumption is the mature forest that covered much of Western Washington before European settlement. WSDOT's Highway Runoff Manual proposes an alternative scenario in highly developed catchments where streams are already heavily impacted by stormwater runoff. In these cases the pre-developed scenario is defined by the existing land cover breakdown within the Drainage Analysis Unit that is impacted by the project. We have identified stormwater mitigation requirements for both scenarios, to provide a range of potential storage volumes and flow impacts.

WSDOT's Highway Runoff Manual requires projects to provide retrofitted stormwater mitigation for existing pavement when new surfaces increase the total impervious area by 50 percent or more within the project area. Stormwater impacts were evaluated assuming that full retrofit will be required for the I-405 and SR-520 projects. Stormwater mitigation needs for the section of SR 520 west of I-405 were taken di-

rectly from data presented for the 6-lane alternative in the SR 520 Preliminary Design Report (CH2M Hill and Parametrix Inc., 2004).

Methods follow Gersib et al. (2004), Part II, Step 7C.

Results

Table D-14 summarizes impacts to 2-year and 100-year peak runoff rates from the project area within each drainage basin. Paved areas generate an average of 33 inches of annual runoff, compared to only 7 inches from forested till soils. Paving forested land on till soils increases the 100-year peak flow rate from 50 cfs/square mile to 390 cfs/square mile. Impacts are much greater where the highway covers outwash soils (Juanita Creek, Goff Creek), since these soils produce almost no runoff under forested conditions.

Stream erosion impacts are usually mitigated using storage and/or infiltration to control the duration of peak flows from the project area. Table D-14 also lists the storage volumes that would be required in each drainage basin to maintain pre-developed peak flow rates and durations. These volumes represent the capacity of a hypothetical detention pond at the top of the outlet structure, and assume no infiltration within the pond.

The highway projects would require a total of 453 acre-feet of detention storage for the forested pre-developed scenario. Defining mitigation relative to existing land cover reduces the total storage needed to 80 acre-feet.

Storage volumes are greatest in areas where the highway covers outwash soils. In areas where the highway is entirely underlain by outwash soils (such as Goff Creek), the model could not find a feasible storage design. Because outwash soils generate little runoff under pre-developed conditions, infiltration is generally needed for effective stormwater mitigation.

Although we identify storage volumes and mitigation for all of the project drainages, several of these areas may be exempt from State stormwater flow control requirements. WSDOT is completing a study to identify exempt reaches in Washington as part of the 2004 Highway Runoff Manual update. Exemptions will be based on drainage area, land cover, and geomorphic criteria. At this time areas that drain directly to Lake Washington qualify for this exemption (including project impact areas in DAU 80). The Sammamish River may not meet the land cover criteria, but is being studied for exemption based on its large drainage area and unique geomorphic setting.

Table D-14. Project Flow Impacts and Storage Needs for each Drainage Analysis Unit

DAU	Catchment	Highway Project	Peak Flow Statistics from project area (cfs)						Storage Needed (ac-ft)	
			2-year			100-year				
			Forested	Existing	Project	Forested	Existing	Project	Forested	Existing
14	North Creek	405	1.6	6.0	9.8	6.2	17.6	31.7	18.5	5.4
15	North Creek	405	1.2	6.7	11.1	4.7	18.3	29.9	22.2	4.8
18	North Creek	405	1.7	12.3	19.7	6.6	32.7	51.6	53.9	8.5
35	Sammamish River	405	1.3	8.1	10.2	5.1	21.8	29.1	18.7	3.4
36	Sammamish River	405	0.2	0.6	1.6	0.7	1.9	4.4	3.0	1.2
41	Juanita Cr-Northern tribs	405	0.3	1.7	2.2	1.0	4.6	6.6	5.4	0.9
59	Juanita Cr-Northern tribs	405	0.7	5.1	8.4	2.5	13.4	21.9	30.2	4.3
58	Juanita Cr-Trib #238	405	0.02	0.4	0.8	0.1	0.9	1.9	**	0.4
67	Juanita Cr-Totem Lake trib	405	0.2	3.0	4.7	0.8	7.5	11.9	47.6	2.0
681	Juanita Cr-Totem Lake trib	405	0.5	3.2	4.3	1.9	8.4	11.5	7.8	1.5
77	Forbes Creek	405	1.2	6.3	11.9	4.6	17.3	30.7	22.1	5.8
80	L. Washington - Kirkland	405	1.2	10.5	15.5	4.7	27.5	39.7	48.2	6.2
98	Yarrow Creek	405	1.9	9.5	18.4	7.1	25.9	49.9	41.6	10.6
104	Sturtevant Creek	405	0.6	4.4	5.7	2.1	11.3	14.3	10.7	1.6
106	Kelsey-Mercer Creek	405	0.3	1.0	3.7	1.2	3.1	8.9	7.5	3.1
101	Lake Washington South	520 west	0.7	3.3	3.7	2.6	9.1	12.7	1.6	NA
98	Yarrow Creek	520 west	0.5	1.9	3.1	1.7	5.3	9.3	3.3	NA
98	Yarrow Creek	520 east	0.6	3.0	5.8	2.4	8.2	15.8	12.5	3.4
105	West Tributary Kelsey	520 east	0.3	3.0	5.6	1.2	7.8	13.7	30.2	2.6
107	Upper Kelsey Creek	520 east	0.02	0.1	0.2	0.1	0.3	0.5	0.4	0.1
97	Goff Creek	520 east	0.04	0.4	1.1	0.2	1.0	2.8	**	0.8
96	Valley Creek	520 east	0.6	3.2	7.7	2.4	8.7	19.2	19.2	4.8
108	Sears Creek	520 east	0.9	6.6	6.9	3.4	17.0	19.6	12.5	1.4
83	Sammamish River	520 east	1.5	8.2	13.3	5.7	22.4	35.4	24.8	5.7
95	Sammamish River	520 east	0.1	1.0	2.4	0.5	2.7	5.6	11.6	1.4
TOTAL			**18**	**109**	**178**	**70**	**295**	**479**	**453**	**80**

Identify Natural Resources Impacts to Avoid and Minimize

The purpose of this step is to provide project management teams with wetland information needed to support decisions regarding the location of highway improvements and the avoidance and minimization of wetland resources. Our goal is to integrate site-specific wetland value information with landscape-scale watershed characterization results to provide information on the overall value of each wetland resource for comparative purposes.

Methods

We ranked wetland resources using methods described in Gersib et al. (2004), Part II, Step 8. The ranking process included looking at each wetland on a site- and landscape-scale. Ecology wetland ranking criteria (Ecology 1993) was used to establish a category score used to assign site-scale condition rank. At a landscape scale, we evaluated each site using ecological process condition rankings and an evaluation of orthophotos to better understand the condition of wetland and riparian resources upslope and down slope of each wetland. A rank score of Low, Moderate, or High was used to characterize the functional importance of each site at the site- and landscape-scales. These scores were then averaged to establish an overall avoidance / minimization rank score.

Results

Table D-1 summarizes wetland resources within the project area and presents the avoidance and minimization ranking for each wetland.

Of the forty wetlands inventoried, 13 Category II wetlands received an overall avoidance and minimization rank of High and 8 received an overall rank of Moderate-High. A Moderate ranking was given to 11 Category III wetlands and a Low-Moderate ranking was given to 1 Category III wetland. Of the remaining Category III wetlands, 2 received a Low ranking. There was one wetland that included both Category II and Category III areas within it and received a rating of Moderate-High. The remaining 4 wetlands were jurisdictional detention ponds and were not rated. Figure 36 in the main document (Wetlands Avoidance and Minimization Map) gives a visual representation of the locations and ratings for the wetlands in the project area

Determine Highway Project Area Potential to Mitigate Unavoidable Impacts

The purpose of this step is to seek to understand the natural capacity of the site to mitigate project impacts within the highway project area. Assessing the capacity of the highway project area to mitigate impacts is assumed to be preferred, when practicable.

Methods

Methods follow Gersib et al. (2004), Part II Step 10.

Results

Using the wetland inventory that was prepared for this project, wetlands were analyzed for their potential to mitigate impacts within the highway project area. Seven of the forty wetlands inventoried contain some potential to mitigation project impacts based on a sites restoration or restoration/enhancement potential. Table D-15 describes these wetlands:

Table D-15**: Potential In Highway Project Area Wetland Restoration Sites**

Wetland Inventory ID	Location	Ecology Category	Approximate Size in Acres
E	I-405: Between I-405 & Totem Lake Blvd.& across from Totem Lake Mall	III	1.7
F	I-405: I-405 & SR 522 interchange, NE Quadrant	III	0.7
G	I-405: I-405 & SR 522 interchange, NW Quadrant	III	2
P	SR-520: North quadrant of the 108th Ave. NE exit westbound	III	0.8
Q	SR-520: South quadrant of the 108th Ave. exit eastbound	III	1.6
R	SR-520: South of 92nd Ave. NE eastbound on-ramp	II & III	4.5
FF	SR-520: NE quadrant of SR-520 & SR-202 interchange	III	4.2

Each wetland has fill material that was placed there during prior construction of the highway. Wetland E contains a partial area of fill material on the west side of the wetland. Wetlands F, G, P, Q contain fill material over mapped and field verified hydric soils. Wetland R includes area that is an Ecology Category II (Ecology, 1993), and area near the on-ramp, which is an Ecology Category III that is underlain by fill material. The Category III area has potential for enhancement, since about half of the site is in this classification. Wetland FF has a large amount of fill that is underlain by soils with redoximorphic features and would provide the largest potential mitigation site.

Wetlands E, F, G, P, Q and FF have the potential to be restored to either functioning Category III or Category II wetlands when the partial or total fill is removed.

Determine Need and Importance of In Highway Project Area Mitigation

The purpose of this step is to focus on the assessment of the need or importance of in highway project area resources for mitigation to the surrounding landscape (Gersib et al., 2004).

Methods

Using the information prepared for the seven wetlands in Part II, Step 10, an analysis was done regarding need or importance to potentially mitigate impacts within the highway project area.

Methods follow Gersib et al. (2004), Part II Step 11.

Results

Wetlands

Wetland E provides location-dependent functions that have been lost from the prior construction of I-405. It is underlain by mapped and field verified hydric soils and it provides a long, narrow area for the function of nutrient, toxicant and sediment removal. There are two large wetland complexes to the east and west; therefore Wetland E may function as part of a migration corridor for wetland birds.

Wetlands F and G, when restored, can provide flood flow alteration and nutrient and toxicant removal. These wetlands may have a marginal function as migration corridors connecting the larger wetland area to the west and smaller areas to the east. Due to the large areas of wetland surrounding this interchange, there is an importance for restoring these wetlands within the highway project area so fewer impacts will occur to the larger systems surrounding the highway.

Wetlands P and Q are underlain by mapped and field verified hydric soils and restoring these wetlands would provide the functions of on-site nutrient, toxicant and sediment removal. These wetlands most likely do not function as a migration corridor.

Wetland R may serve as a migration corridor for wetland birds, since a very large wetland complex lies to the northeast of it on the north side of SR-520. Restoration of this wetland would provide important functions such as flood flow alteration and nutrient and toxicant removal within the highway project area.

Wetland FF is a large restoration area at the SR-202 interchange with SR-520. When restored, this site will provide the function of nutrient and toxicant removal. At the current time, this area provides minimal functions as a migration corridor.

All of these wetlands are either partially or totally within the highway project area.

These results indicate that wetland restoration can be done within the project area to compensate for unavoidable wetland impacts and will likely result in measurable benefits at the site scale. However, to maximize potential for increasing environmental benefits at both the site- and landscape-scales, these on-site restoration options should be compared to off-site wetland restoration options identified and prioritized in the natural resource mitigation priority list, found in Appendix B.

Fish Habitat

The proposed I405/520 corridor widening project has potential to fragment important fish and wildlife habitat based on information contained in Washington State Department of Fish and Wildlife's "Priority Habitat Species" (PHS) database. Reach level assessments (Center for Watershed Protection 2004) were conducted by Kurt Buchanan, fisheries biologist for the Washington Department of Fish and Wildlife. PHS data indicate that approximately 1.2 acres of Forbes Creek riparian habitat and approximately 1.3 acres of wetlands will be affected in the project area, and approximately 9.8 acres of wetlands in the North Creek catchment will be affected in the project area. In addition, the reach level assessments conducted by WDFW staff indicate that Forbes Creek and North Creek contains high quality habitat based on their scores of 107 and 103, respectively. Forbes Creek is not identified by WDFW as supporting any PHS salmonid species, however, North Creek is identified as supporting runs of fall chinook, coho, and sockeye salmonid species.

The surrounding area has already been altered through the construction of the current I-405 highway corridor, as well as surrounding land-use that consists of predominantly urban/residential, industrial, and commercial building. With the exception of the two above mentioned priority habitat sites, habitat at the stream crossings is marginal to poor.

Habitat restoration can be done within the project area to compensate for unavoidable fish habitat impacts and will likely result in measurable benefits at the site scale. However, due to a) the consistently degraded condition of the surrounding landscape, b) the long-term effects of poor ecological process condition on existing fish habitat, c) increased risk of the destruction of on-site mitigation sites if / when future highway projects are needed, and d) foundational assumptions we make in watershed characterization, we anticipate that environmental investments for fish habitat within the project area would have less overall environmental benefit to the resource than investments placed strategically outside the project area.

Determine if Potential in Highway Project Area Mitigation is Sustainable

The purpose of this step is to assess the likelihood that in highway project area mitigation opportunities have potential to maintain area and function over the long-term.

Methods

The on-site wetland restoration and enhancement sites identified in Steps 10 and 11were analyzed for potential to maintain area and function over the long-term. Potential temporal change in ecological processes was evaluated using the change in percent TIA calculated from current and future land cover estimates, developed earlier. Best professional judgment was used to determine if functions established under current conditions can be maintained over the long-term.

Results

Table D-16 describes the on-site wetlands having restoration potential and the anticipated change in percent Total Impervious Area (TIA) for the DUA in which each wetland occurs.

Table D-16. Potential In Highway Project Area Wetlands Maintaining Long-Term Functions

Wetland ID #	Location	DAU	Ecology Category	Approx. Size in Acres	Current %TIA	Future %TIA
E	I-405: Between I-405 & Totem Lake Blvd.& across from Totem Lake Mall	67	III	1.7	49%	49%
F	I-405: I-405 & SR 522 interchange, NE Quadrant	18	III	0.7	47%	47%
G	I-405: I-405 & SR 522 interchange, NW Quadrant	18	III	2	47%	47%
P	SR-520: North quadrant of the 108th Ave. NE exit westbound	98	III	0.8	37%	38%
Q	SR-520: South quadrant of the 108th Ave. exit eastbound	98	III	1.6	37%	38%
R	SR-520: South of 92nd Ave. NE eastbound on-ramp	98	II & III	4.5	37%	38%
FF	SR-520: NE quadrant of SR-520 & SR-202 interchange	86	III	4.2	49%	51%

All potential wetland restoration sites located within the project area occur within DAUs that are considered “not properly functioning” for the delivery and routing of water. Comparative analysis of the change in percent TIA from current to future conditions indicate that DAUs supporting these wetlands have reached a built-out condi-

tion with little further change in land use intensity. However, to maximize potential for increasing environmental benefits at both the site- and landscape-scales, these on-site restoration options should be compared to off-site wetland restoration options identified and prioritized in the natural resource mitigation priority list, found elsewhere in this document.

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